SilverSneakers®

Splash

Aquatic Exercise Principles

A. Physiology and the aquatic environment

Aquatic exercise programming provides a unique opportunity to increase functional capacity while improving activities for daily living. The aquatic environment challenges and supports exercisers with viscosity, buoyancy, and hydrostatic pressure. Effective understanding and utilization of the aquatic environment promotes safe and effective exercise program design, while utilizing the therapeutic benefits of the water to help manage chronic conditions.

1. Viscosity is resistance that occurs between molecules that cause the molecules to adhere to each other and to the submerged body. The resistance of water is 12 to 20 times greater than that of air. Viscosity provides resistance to motion.

2. Hydrostatic pressure is exerted by molecules of a fluid on an immersed body, affecting the entire body (both the internal organs and skin) and increases with depth. Hydrostatic pressure provides the following benefits:

    - Decreases edema or swelling
    - Decreases nausea
    - Aids venous blood return to the heart from lower extremities
    - Creates lower heart rates in aquatic exercise than in land-based exercise without losing cardiovascular or aerobic benefits
    - Assists in removal of lactic acid from cells and more efficient delivery of lactic acid to the liver, reducing potential for delayed onset muscle soreness
    - Increases kinesthetic awareness or awareness of the body in space to coordinate motion
    - Pressure exerted on chest wall helps build strength with each inhalation

3. Buoyancy is the upward force created in the aquatic environment, while gravity exerts a downward force. The Archimedes Principle states that the buoyant force on a submerged object is equal to the weight of the fluid that is displaced by that object. An object in water is subject to two opposing forces: buoyancy and gravity. Several variables contribute to a person's buoyancy: percentage of body fat, relative density, body size and lung capacity. Buoyancy decreases the effects of gravity and reduces compression in joints. Buoyancy can assist or resist movement in water.

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4. Specific to the older adult population

- According to the Journal of Strength and Conditioning Research, water can reduce joint pain. When compared to land-based exercise rehabilitation programs for knee replacement, water exercisers have demonstrated the same improvements in thigh girth, 1-minute walk time, and knee range of movement, but subjective pain levels were significantly less in the aquatic group when compared with the land-based group. *(Wyatt, Frank, et al.)*
- Water exercise works. In a study of the effectiveness of a regular aerobic and resistance aquatic training program for women over 60 years of age, muscle strength (isometric and dynamic), flexibility, and functional mobility were examined. The regular program of cardiovascular training and resistance training produced significant improvements in flexibility, lean mass, and total body strengthening. The results indicate that high-intensity aquatic training, with both aerobic and resistance components, is an alternative training method for improving neuromuscular and functional fitness performance. *(Tsourlou, Thomal, et al.)*
- Water exercises can be a beneficial way to prevent falls. After undergoing a lower-body muscular endurance training program, participants experienced improved static and dynamic balance, similar to that of land -based training programs. There is a growing trend within the clinical environment to indicate aquatic exercises for individuals who are afraid of, or who are at risk of falling. *(Avelar, et al.)*

B. Movement principles

Instructors must consider a variety of factors when designing an aquatic exercise class. Water principles such as heat dissipation and hydrostatic pressure may affect participant comfort, while movement principles like inertia and action/reaction may help guide exercise intensity. Newton's Laws of Motion can be applied to increase or decrease exercise intensity in the water. Viscosity makes these laws easier to observe than in land-based exercise classes. Understanding movement principles will help aquatic exercise instructors create a comfortable environment while still challenging participants to meet their health and fitness goals.

1. **Drag** is our primary resistance in aquatic exercise. Viscosity causes movement in water to slow down quickly and thus the effects of drag become readily apparent. By altering speed and surface area, intensity can increase or decrease. Small, fast movements require adjustments to range of motion. Decrease range to increase speed and reduce energy expenditure.

   Several factors affect the amount of drag:
   - Viscosity of the water, which varies with temperature
   - Relative velocity of the moving object
   - Surface area of the object

   - To increase intensity, increase the surface area of your hand by cupping or clawing the water or add the Splashboard.
   - To decrease intensity, slice or make a fist in the water. An open hand provides a moderate intensity option.

2. **Inertia** is the tendency of objects to resist changes in motion or movement. An object at rest tends to stay at rest. An object in motion will move at a constant speed within a constant plane of movement until acted upon by an outside force.

Inertia plays an important role when choosing intensity options. If choreography includes several repetitions of the same movement, or if a participant stays in one place during movement, intensity decreases because the need to apply force to overcome inertia decreases. On the contrary, if choreography uses fewer repetitions of a movement but includes traveling or direction changes, movement intensity increases. By altering working position, repetitions and travel options, exercise intensity can increase or decrease.

- To increase intensity, combine movements to start, stop and change direction. Add travel. Perform fewer repetitions.
- To decrease intensity, stay in place. Add more movement repetitions.

3. **Acceleration.** Newton's Second Law of Motion describes how quickly an object will change its direction and speed when force is applied. Velocity expresses the exact relation between force and acceleration. An object with greater mass requires more applied force to change its speed than does an object with lesser mass. Additionally, the direction of acceleration is the same as that of the applied force.

   Encouraging a participant to travel a greater distance by taking larger steps, or leaping farther in the same amount of time, increases intensity. Using space in this manner allows for higher intensity options, just as less space and a slower pace decreases intensity. Heavier exercisers have to exert more energy than lighter ones to achieve the same degree of movement. Acceleration is not simply an increase in speed. To be more accurate, acceleration is applying more force to one's limbs or entire body through a greater range of motion at the exact same tempo.

   - To increase intensity, push harder against the water's resistance or the pool floor. Incorporate movements like rebounding. Work in the extended or suspended position.
   - To decrease intensity, reduce range of motion. Take smaller steps or work in a neutral position.

4. **Action/Reaction**. For every action there is an equal and opposite reaction. Newton's Third Law is about the interaction between two bodies.

   An individual can increase or decrease exercise intensity by using impeding or assisting arm movements. Stabilizing the torso while moving arms and legs increases core strength (e.g., standing or jogging in place while using a strong breast stroke).

   - To increase intensity, use impeding arm and leg movements.
   - To decrease intensity, use assisting arm and leg movements.

5. **Leverage**. Increasing lever length increases the intensity of any exercise. Lever length, especially when used in combination with frontal resistance (travel), turbulence (currents and eddies) and acceleration (increasing applied muscular force) can be a very effective variable to increase or decrease exercise intensity. Although instructors can use a longer lever during class to increase intensity, we recommend using short lever movements during warm up with gradual progression to longer levers to avoid injury.

   - To increase intensity, use long levers with extended arms and legs.
   - To decrease intensity, use shorter levers with flexed arms and legs.

6. **Turbulence** can be an effective tool to create resistance and require more muscle recruitment. Applying drag and turbulence in exercise selection challenges participant core stabilization and gives the instructor tools for developing core strength and stability. These competencies are important factors in protecting against and managing chronic low back pain.

Turbulent flow is the irregular movement of a fluid with movement varying at any fixed point. Turbulence creates currents and eddies that decrease movement efficiency, thereby increasing movement intensity. Smooth, streamlined movement through water creates resistance that is proportional to velocity. Turbulent movement, however, creates resistance that is proportional to velocity squared.

To increase turbulent flow, apply Newton's laws of motion:

- Increase frontal resistance with traveling movements.
- Increase lever or limb length.
- Change hand positions.
- Use opposing arm and leg movements.